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Supporting Information

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Programmed Synthesis of Freestanding Graphene Nanomembrane Arrays

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Supporting Information

Programmed Synthesis of Freestanding Graphene Nano-Membrane Arrays

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Analysis of Raman Spectra

The quality and uniformity of CVD graphene are characterized by the I_{2D}/I_G ratio, the peak positions of the 2D and G bands and the full-width at half-maximum (FWHM) of the 2D band as obtained from a single-Lorentzian fit.[1-3]. Further, it is generally accepted that an I_{2D}/I_G ratio located between 0.8 and 1.4 represents the formation of bilayer graphene, while I_{2D}/I_G ratio > 1.4 represents monolayer graphene. Few-layer graphene with more than three layers are generally identified with an I_{2D}/I_G ratio < 0.8. I_{2D}/I_G ratio for the three membranes that we tested lies between 0.9 and 1.0, which provides evidence of formation of two-/three-layer graphene (Table S1). In addition, peak positions of G and 2D bands and FWHMs of 2D and G bands also confirm the formation of two/three-layer AB Bernal graphene (Table S1) over the nano-holes on low-stress SiN_x freestanding window.[4]

Table S1. Various fingerprints values extracted from Raman spectra of three graphene membrane devices.

Device Number	G-band position (cm^{-1})	2D-band position (cm^{-1})	G-band width (cm^{-1})	2D-band width (cm^{-1})	I_{2D}/I_G
1	1583	2728	15	54	0.93
2	1580	2710	25	68	1.00
3	1581	2718	36	77	0.99

Determination of mean DNA dwell times

First, a histogram of logarithm of dwell time (t_d) for a given data set is plotted to determine the mean peak dwell time ($<t_d>$). Then we perform a least squares fit of the histogram to a Gaussian. The $<t_d>$ is determined from the position of this Gaussian's mean, which is considered as the characteristic dwell time for the experiment. Each distribution has two peaks in the voltage range 225-300 mV - the longer dwell time represents the DNA translocation while the other represents the collisions, which exhibit negligible voltage dependence. As the bias voltage is increased the dwell time peak moves to the left, while the collision peak remains the same. In all cases, the double-stranded DNA (dsDNA) and the pore are the same, except the different bias voltages.

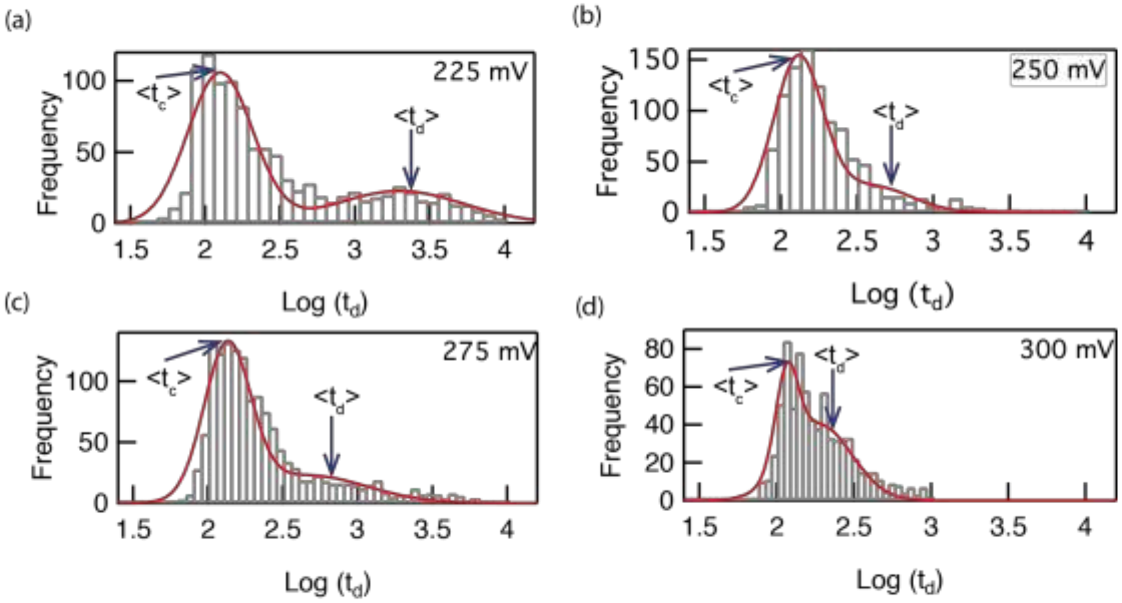

Figure S1: Dwell time analysis. (a), (b), (c), (d). Histograms of logarithm of dwell times for dsDNA for 8 nm graphene pore at 225, 250, 275, 300 mV bias voltage, respectively. The distribution fits to two Gaussians, where the longer dwell time represents the DNA translocations, while the other represents the collisions.

EDS analysis of a graphene nano-membrane

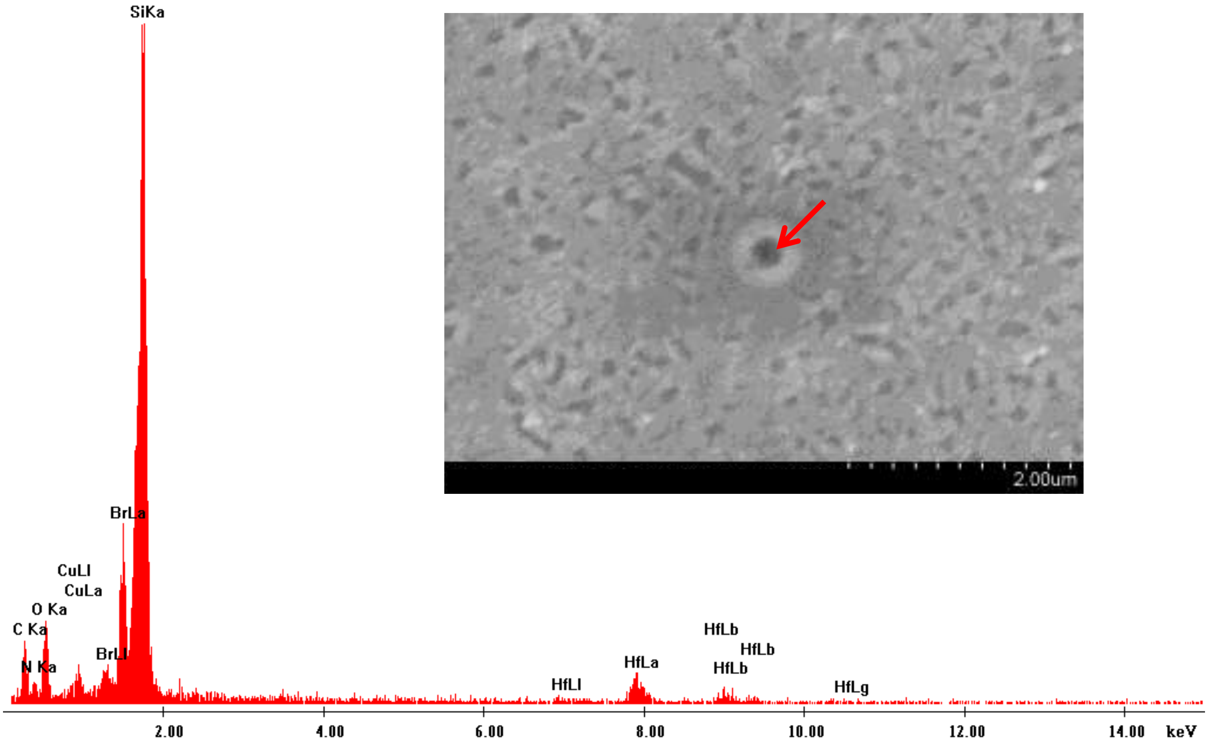

Figure S2: Scanning electron microscopy (SEM)-based energy dispersive X-ray spectrometry (EDS) acquired for a graphene nanomembrane (see inset) following treatment with ammonium persulfate and rinse. Since the membranes are <500 nm signal from the supporting substrate was unavoidable. The major band at 1.8 keV corresponds to the Si substrate, whereas only trace amounts of Cu were found as compared with C. Finally, peaks that correspond to the Hf and O from the atomic-layer deposition of HfO_2 were observed.

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